PATENT SPECIFICATION

DRAWINGS ATTACHED.

1,185,314

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1,185,314

Date of Application (No. 59284/68) and filing Complete Specification: 24 April, 1967.

(Divided out of No. 1,185,313).

Complete Specification Published: 25 March, 1970.

Index at acceptance:—F1 C(1D, 2F1).

International Classification:—F 04 d 29/24.

COMPLETE SPECIFICATION.

Improvements in or relating to Centrifugal Pumps.

We, SPEEDWELL RESEARCH LIMITED, a British Company, of Tame Road, Witton, Birmingham 6, in the County of Warwick, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to centrifugal pumps for pumping liquid. In such a pump there is a rotatable impeller which causes liquid entering the inlet of the pump to acquire a centrifugal velocity relative to the axis of rotation of the impeller and liquid is thus delivered from an outlet of the pump.

At the eye of the pump, i.e. around the axis of rotation of the impeller in the region of the pump inlet, there is a tendency for cavitation to occur in the liquid being pumped with a consequent decrease in pumping efficiency.

It is an object of the present invention to provide a centrifugal pump in which the tendency to cavitation is reduced as compared with centrifugal pumps at present generally in use.

According to the invention we provide a centrifugal pump comprising a casing having a front wall, a rear wall and a peripheral wall which together define a pump chamber, an impeller rotatable in said chamber through said rear wall, an inlet in the front wall of the casing and disposed symmetrically about the axis of rotation of the impeller, the impeller having a hub and blades extending therefrom, the blades each having a first portion which extends outwardly from the hub and which, when the pump is in use, accelerates liquid entering the inlet centrifugally of said axis, and a second portion located within said inlet and having a part projecting transversely from the first portion at an angle such as to reduce the tendency to cavitation at the eye of the pump when the latter is in operation, the maximum radial and axial dimensions of the first portion of each blade being greater, respectively, than the maximum radial and axial dimensions of the second portion of the blade and the maximum transverse extension of said part of the second portion of each blade from the first portion thereof being greater than the maximum thickness of the first portion measured in planes perpendicular to said axis.

By "radial" and "axial" dimensions we mean dimensions measured respectively radially of and parallel to the axis of rotation of the impeller. By the "transverse extension" of the part of the second portion we mean the extension of said part in directions lying in planes perpendicular to said axis.

Preferably said part of each second portion has arcuate outer and inner edges.

In a preferred construction, the impeller has only two blades, the first portions thereof being straight and extending radially from the axis in diametrically opposite directions.

An embodiment of the invention will now be described in detail by way of example with reference to the accompanying drawings in which:—

Figure 1 is a side elevation of a centrifugal pump embodying the invention, half of the pump being shown in section:

Figure 2 is an end elevation of the pump of Figure 1, part of the pump being shown in section; and

Figure 3 is a perspective view of the impeller of the pump of Figures 1 and 2.

Referring to Figures 1 and 3, the pump comprises a casing indicated generally at 10, an impeller generally indicated at 11 and rotatable within the casing on a shaft 12, an inlet indicated generally at 13 and an outlet indicated generally at 14. When the pump is in use, liquid flows into the inlet 13, is accelerated centrifugally of the axis of rotation of the impeller by the impeller 11 and is delivered from the outlet 14. The pump illustrated is intended for pumping corrosive chemical substances and for this reason the casing is made of titanium. The casing comprises a front wall 15, a rear wall 16 and a peripheral wall 17 in the form of a ring. The front wall 15 is in the form of a plate-like annulus of titanium which has a flat inner surface 18 and a flat outer surface 19. Around its peripheral edge, the inner surface 18 is relieved to provide a recess 20. Similarly, the rear wall 16 has a flat inner surface 21 which is relieved adjacent its periphery to provide a recess 22. The recesses are of such size as snugly to receive the wall 17 which in turn is recessed to receive two ring-like gaskets 23 which ensure a liquid-tight joint between the front and rear walls 15 and 16 respectively and the peripheral wall 17. The three walls 15, 16 and 17 are held together by a series of bolts 24, eight in number, which pass through the front wall 15, the ring-like peripheral wall 17, and the rear wall 16. The bolts also pass through a forward casting 25. As has been mentioned above, the wall 15 is made of titanium and the walls 16 and 17 are also made of titanium. The configurations of the various walls are such that they can be comparatively easily machined from titanium with little waste. The inner surfaces 18 and 21 of the walls 15 and 16 are flat and merely have to be relieved to provide the recesses 20 and 22 for the wall 17. The outer surface 19 of the wall 15 is flat but the outer surface of the wall 16 is provided with a recess indicated generally at 26.

Referring particularly to Figure 2, the wall 17 has an outer surface 27 which is eccentric with respect to the inner surface 28. Both surfaces are cylindrical, the surface 28 being co-axial with the rotary axis 29 of the impeller. The thickness of the wall 17 therefore varies from a minimum thickness at approximately the position 30 to a maximum thickness adjacent the position 31 as indicated in Figure 2. The outlet 14 of the pump comprises a spigot 32 which is threaded at 33 and is engaged in a bore 34 provided in the wall 17 adjacent the position 31, i.e. where the wall is thickest. The bore 35 of the spigot 32 provides a divergent nozzle and the outer end of the spigot is provided with a flange 36 which is threadedly engaged at 37 with the spigot and rests on a shoulder 38 thereon. Since the outlet is threadedly engaged with the wall 17, the outlet can, when necessary, be removed and a fresh outlet replaced in the wall. This is important in two respects, firstly, the outlet is the part of the pump which encounters the most wear and therefore will have to be replaced first and this can easily be done by the pump user. Secondly, should the pump user wish to change the delivery characteristics of the pump he can replace a given outlet 14 by another outlet having different characteristics.

The shaft 12 extends from an electric motor, or bearing pedestal, not shown, and passes through an aperture 39 in the rear wall 16. The shaft is surrounded by a sleeve 40 and is pinned thereto by means of a taper pin 141.

The impeller 11 is shown in detail in Figure 3 and comprises a hub portion indicated generally at 41 having a tubular part 42 which fits over a part 43 on the shaft sleeve 40. The sleeve 40 is provided with a threaded end 44 and a square portion 45 is received in an aperture 46 of generally square section in the hub 41. The impeller is retained in position on the sleeve by means of a bullet 47 which is threadedly engaged with the screw-threaded end 44.

The impeller has two blades extending from the hub. Each blade has a first, straight portion 48. The portions 48 extend in diametrically opposite directions from the part 42 of the hub and also extend rearwardly therefrom as indicated at 49. The first portions of the blades sweep out a volume which is substantially that defined between the inner surfaces 18 and 21 of the walls 15 and 16 and the inner surface 28 of the peripheral wall 17. As will be seen from Figure 1, there is a working clearance between the various walls and the blade portions 48.

Each blade also has a second portion or horn 51 a part 51*c* of which projects transversely of the first portion. The second portions 51 lie within an aperture 50 in the front wall 15, which aperture constitutes the inlet 13. Each part 51*c* of each second portion has an arcuate inner edge 51*a* and an arcuate outer edge 51*b*. The second portions or horns 51 act to reduce the tendency to cavitation at the eye of the pump and the angle between each first portion 48 and the part 51*c* of the second portion or horn 51 carried thereby will be chosen for maximum efficiency in reducing cavitation.

It will be seen that the maximum radial dimension of each first portion 48, i.e., its radial extension from the axis of rotation of the impeller, is greater than the maxi-

mum radial dimension of each second portion 51. The maximum axial dimension of each first portion 48, i.e. its extension parallel to the axis of rotation of the impeller, is greater than the maximum axial dimension of each second portion 51. Moreover, the maximum transverse extension of each part 51*c*, i.e. its extension in planes perpendicular to said axis, is greater than the maximum thickness of each first portion 48 measured in planes perpendicular to said axis.

Where the shaft sleeve 40 passes through the aperture 39 there is a seal arrangement indicated generally at 52. This seal arrangement is the subject matter of our Patent Application No. 19910/66 (Serial No. 1,185,312) and will therefore not be described in detail. Basically the seal comprises an auxiliary impeller 53 which is keyed to rotate with the sleeve 40 and which, when the pump is operating, produces a pressure-balanced, liquid-ring seal. When the pump is stationary, a diaphragm 53*a* can come into contact with a shoulder 56 on the sleeve 40 to form a static seal.

The casting 25 through which the bolts 24 pass is provided with a recess 54 to receive the outer periphery of the rear wall 16 and also helps to form part of the chamber within which the auxiliary impeller 53 rotates. The casting 25 is secured by socket-head screws 55 to a further casting 60 of frusto-conical form, the casting 60 having a flange 61 which is connected by socket-head screws 62 to a motor plate 63 which in turn is connected by bolts 64 to the motor, not shown. The casting 60 is is provided with a diaphragm 65 which may be made of titanium (or other material) and between the inner edge 66 of the diaphragm and the outer surface of the sleeve 40 there is a very small clearance. The outer edge of the diaphragm is secured in a recess 67 in the casting 60 by means of screws 68. A drain 69 is provided in the casting 60 and an inlet 70 for flushing the seal 52 is provided and is formed partly in the casting 25 and partly in the wall 16.

Liquid is supplied to the pump through a pipe which is formed with a normal flange which may be bolted to the front wall 15 by being received on studs 71 projecting from the front wall. Alternatively, the operture 50 may be threaded to receive an inlet spigot in the same manner as the spigot 32 of the outlet is received in the peripheral wall 17. Liquid is removed from the pump by means of a pipe having a flange which is bolted to the flange 36 of the outlet 14.

When the pump is in use, liquid enters the inlet 13, is accelerated centrifugally by the blade portions 48 of the impeller 11 and is delivered through the outlet 14. The second portions or horns 51 serve to reduce the tendency to cavitation at the eye of the pump.

The construction of the casing of the pump shown in the accompanying drawings is described and claimed in the Complete Specification of our Application No. 19911/66 (Serial No. 1,185,313).

WHAT WE CLAIM IS:—

1. A centrifugal pump comprising a casing having a front wall, a rear wall and a peripheral wall which together define a pump chamber, an impeller rotatable in said chamber through said rear wall, an inlet in the front wall of the casing and disposed symmetrically about the axis of rotation of the impeller, the impeller having a hub and blades extending therefrom, the blades each having a first portion which extends outwardly from the hub and which, when the pump is in use, accelerates liquid entering the inlet centrifugally of said axis, and a second portion located within said inlet and having a part projecting transversely from the first portion at an angle such as to reduce the tendency to cavitation at the eye of the pump when the latter is in operation, the maximum radial and axial dimensions of the first portion of each blade being greater, respectively, than the maximum radial and axial dimensions of the second portion of the blade and the maximum transverse extension of said part of the second portion of each blade from the first portion thereof being greater than the maximum thickness of the first portion measured in planes perpendicular to said axis.

2. A pump according to Claim 1 wherein said part of each second portion has arcuate radially outer and inner edges.

3. A centrifugal pump according to either of the preceding claims wherein the impeller has only two blades, the first portions thereof being straight and extending radially from said axis in diametrically opposite directions.

4. A centrifugal pump comprising a casing with an inlet aperture in a front wall thereof and having an impeller substantially as hereinbefore described with reference to and as shown in Figure 3 of the accompanying drawings, the impeller being arranged in the casing and having parts rotating in the inlet aperture substantially as hereinbefore described with reference to and as shown in Figures 1 and 2 of the accompanying drawings.

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Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1970.
Published at The Patent Office, 25 Southampton Buildings, London, W.C.2,
from which copies may be obtained.

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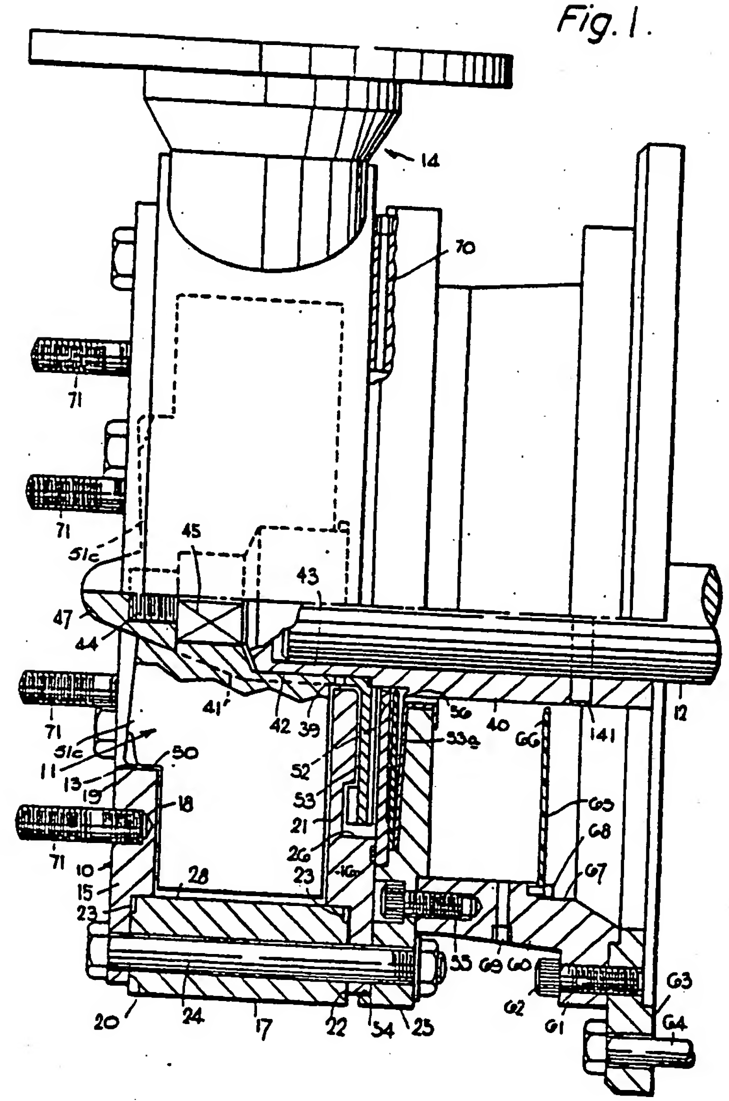
Sheet 1

Fig. 1.



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Sheet 2

Fig. 2

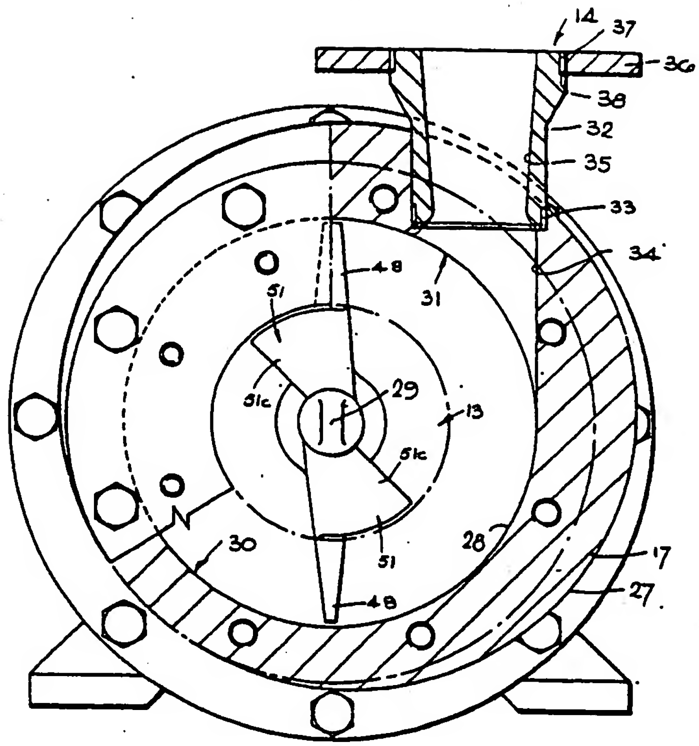

Fig. 3.